REMARKS/ARGUMENTS

The Applicant has filed the present Response in reply to the outstanding Official Action of September 30, 2003 and the Applicant respectfully submits that the Response is fully responsive to the Official Action for reasons set forth below.

In the present Official Action, the Examiner has rejected Claims 1-20 pursuant to 35 U.S.C. § 103(a), as allegedly unpatentable over Katata, *et al.* (U.S. patent application no. 5,631,644) (hereinafter "Katata") in view Katta, *et al.* (U.S. patent application no. 6,173,012) (hereinafter "Katta").

In traversing the rejection of the independent Claims 1 and 11 pursuant to 35 U.S.C. § 103(a), the Applicant respectfully submits that the Katata-Katta combination is defective in that it fails to teach or suggest a quantization step size setting means (and step) for calculating average complexity of whole coded data from the quantization step size provided to the video coding means and also the generated code bit count provided from the video coding means, as particularly recited in the independent Claims 1 and 11. In this regard, the Examiner acknowledged that the primary prior art reference to Katata is deficient in that fails to teach or suggest the quantization step size setting means for calculating average complexity of whole coded data. The Applicant agrees. However, the Examiner has cited the secondary prior art reference to Katta to overcome the acknowledged deficiency in Katata. In this regard, the Applicant respectfully submits Katta fails to rectify the acknowledged deficiency in Katata. More specifically, in accordance with presently claimed invention, the average coding complexity of the entire

image data coded so far (whole coded data) is calculated from the quantity of the generated codes (generated code bit count) obtained so far and the quantization width (quantization step size), and the reference quantization width is calculated from this average coding complexity and the target average bit rate. Katta is directed to a moving picture encoding apparatus. In Fig. 3-4, Katta teaches a complexity detector 4 for calculating the difficulty in encoding, i.e., complexity (See Katta Col. 5, lines 48-50). More specifically, in Katta's system, prior to the coding process the complexity is calculated in the complexity detector 4 using the input data and the result of motion detection. (See Katta Col. 5, line 66; and Fig. 3). However, to the contrary of the claimed invention, which calculates average coding complexity of whole coded data, Katta calculates the complexity in macroblock units or picture units, where each picture unit is a summation of macroblock units in the picture (See Katta Col. 6, lines 18-25). Consequently, the Katta's calculated complexity is one for a fixed period of time such as macrblock or picture, and therefore, Katta does not teach or suggest the average coding complexity of the entire image data coded so far (whole coded data).

In further traversing the rejection of the independent Claims 1 and 11 pursuant to 35 U.S.C. § 103(a), the Applicant respectfully submits that the Katata-Katta combination is also defective because it fails to teach or suggest setting a reference quantization step size for each first image unit corresponding to the target average bit rate from the average complexity. More specifically, the primary prior art reference to Katata controls the generated code quantity to be substantially the same for each GOP because the remaining code quantity in the GOP that is capable of being utilized is distributed for

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each picture type. However, because the quantization step size varies with the difficulty of the input image, this adversely affects the coded image quantity. To the contrary of Katata, the claimed reference quantization step size is calculated from the results of the average complexity calculation and the target average bit rate (See present specification on page 26, lines 15-28). Thus, the claimed invention enables much better image quality, i.e., using variable bit rate coding. The secondary prior art reference to Katta does not rectify the deficiency identified in Katata.

More specifically, based on the foregoing arguments, Katta's calculation of complexity per macroblock or picture is distinguished from claimed calculation of average complexity of whole coded data. Thus, the Applicant respectfully submits that this necessarily means that Katta is further distinguished from the present invention in the calculation of the quantization step size used for the coding and code quantity distribution. In Katta, first the code quantity distribution per GOP is determined, and the code quantity distribution is executed based on the complexity per picture, thus determining the quantization step size. The code quantity per GOP is controlled by dispersing the difference from the target code quantity in a plurality of GOP periods (T GOP Periods) (See Katta Col. 6, line 58 – Col. 7, line 29; and Col. 7, equation 9). In other words, the allotment code quantity of GOP to be coded is determined only from the quantity of codes generated so far and the target code quantity. This means that Katta gives no consideration to the relation between the coding complexity of the GOP to be coded and the average coding complexity of the entire image data coded so far. Thus, when the target code quantity is exceeded by the quantity of codes generated so far, the

coding complexity of GOP to be coded is high, and appropriate code distribution cannot be obtained even though a large number of codes are required. However, in accordance with the present invention, the quantization step size per GOP as the first image unit, is calculated from the average coding complexity of the entire image data coded so far and the target average bit rate. (See present specification page 26, line 15 to page 27, line 8). Therefore, in accordance with the present invention, because the quantization step size is matched to the average coding complexity, when the complexity of GOP to be coded is higher than the average, more codes than the average bit rate are allotted. On the contrary, when the coding complexity of GOP to be coded is lower than the average, fewer codes than the average bit rate are allotted. Consequently, since the allotted code quantity is determined based on the relative value of the average complexity of GOP to be coded, it is possible to allot more codes for a scene requiring more codes and fewer codes for a scene needing fewer codes. Therefore, unlike the Katata-Katta combination, the claimed invention realizes variable bit rate coding.

Consequently, the Applicant respectfully submits that the primary prior art reference to Katata fails to teach or suggest the quantization step size setting means (and step) for calculating average complexity of whole coded data from the quantization step size provided to the video coding means and also the generated code bit count provided from the video coding means and for setting a reference quantization step size for each first image unit corresponding to the target average bit rate from the average complexity, as particularly recited in the independent Claims 1 and 11..

Still further traversing the rejection of the independent Claims 1 and 11 pursuant to 35 U.S.C. § 103(a), the Applicant respectfully submits that the Katata-Katta combination does not teach or suggest a quantization step size adjusting means for calculating a bit balance of the generated bit count with respect to the target average bit rate with a virtual buffer that is independent of picture types and for adjusting the reference quantization step size provided from the quantization step size setting means for each second image unit from the bit balance. Regarding this feature, the Examiner merely pointed to Katata's Col. 6, lines 20+, which teaches adjusting the number of occupied bits in temporary storage means (buffer) to avoid underflow or overflow (buffer fullness). The secondary prior art reference to Katta does not address this feature. Thus, to the contrary of the claimed invention, Katata teaches calculating the buffer fullness of each picture type and performing quantization step size control based on the difference between the desired code quantity and the actual generated code quantity of each picture type (See Katata Col. 3, lines 46-58). The buffer fullness is set for each picture type, and also the desired code quantity is set for each picture type. However, the claimed invention uses a virtual buffer which is not based on picture type for measuring the balance of the generated code quantity with respect to the average rate and thus adjusting the reference quantization step based on the balance (See present specification on page 26, line 1; page 29, lines 8-24).

More specifically, in the present invention, a single virtual buffer is provided, and the excess/lack from the average bit rate of the generated code quantity (generated bit count) is calculated (See present specification page 26, line 11). As

described in the specification, the equation vboc=vboc + Sj – Rave_mb represents the buffer occupation quantity of the virtual buffer (vboc) and integrates the difference between the generated code quantity of the macroblock and the average code quantity per macroblock. In the equation, Sj is the generated code quantity of the j-th macroblock; Rave_mb is the average code quantity per macroblock that can be calculated from the target average bit rate. Thus, when the generated code quantity is above the average quantity, the value of vboc is increased, while the value of vboc is reduced when the generated code quantity is below the average quantity. Since the difference from the average is thus calculated, vboc shows the excess/lack from the average rate of the generated code quantity. When vboc is positive, the generated code quantity at this time is above the total code quantity obtainable from the target average bit rate, whereas when vboc is negative the generated code quantity is below the total code quantity. In accordance with the invention, the quantization step size is controlled using the foregoing virtual buffer occupation quantity vboc (See present specification page 29, lines 8-24).

To the contrary of the claimed invention, Katata's buffer fullness for each picture type is used for the quantization step size control (See Katata Col. 3, lines 45-58). More specifically, Katata teaches an equation dj = d0 + B(j-1) – T/MBcnt (j-1). In this equation, B(j) is the generated code quantity up to the j-th macroblock in that picture; T/MBcnt (j) is the target code quantity up to the j-th macroblock in that picture; and B(j-1) – T/MBcnt (j-1) thus represents the difference between the generated code quantity and target code quantity at the instant right before the j-th macroblock coding. The buffer fullness of the j -th macroblock is calculated by adding a bias value of d0 to the difference

value, i.e., B(j-1) – T/MBcnt (j-1). The resultant value (dj) is used for the quantization step size adjustment. (See Katata Col. 8, lines 53-58). Here, T is the target code quantity of a picture, and since it is set for each picture type, it is not the average bit rate (See Katata Col. 3, lines 11-24). Thus, Katata's control is for matching the target code quantity for each picture and not one for directly matching the average bit rate. While the average rate control is realized by code allotment per GOP (See Katata, Col. 3 lines 25-26.), the excess/lack control from the average rate is executed for each GOP. This means that the evaluation of the excess/lack from the average rate is made in long cycle. Therefore, in this unit the generated code quantity may be greatly deviated from the average rate, and the allotted code quantity per quantization step size or GOP may be greatly deviated with the GOP unit. Consequently, image quality variation of the coded image may be brought about.

However, to the contrary of Katata, variable bit rate control in accordance with the present invention is executed based on the difference from the average rate for each macroblock as the second image unit. (See present specification page 25, lines 1-9). Since the average bit rate control is executed in a finer unit than Katata, image quality will not be suddenly varied, and it is thus possible to control variation of the reference quantization step size for each macroblock and to stably control the image quality.

In addition, Katata's buffer provisionally accumulates coded data (See Katata Fig. 1, buffer 6), and such control is made that neither overflow nor underflow of the buffer takes place. The target code quantity is controlled from the buffer occupation ratio for evading the overflow. However, for evading the underflow the apparent target

code quantity is increased by inserting dummy data and the code quantity control method is different. Katata's control is thus one for accommodating the difference between the generated code quantity and the output rate from the buffer in a predetermined range, i.e., the buffer size range. This control is provided from the threshold judgment with respect to the buffer occupation quantity, and is not provided unless the buffer occupation quantity is under a borderline condition.

Consequently, the Applicant respectfully submits that the primary prior art reference to Katata fails to teach or suggest the quantization step size adjusting means (and step) for calculating a bit balance of the generated bit count with respect to the target average bit rate with a virtual buffer that is independent of picture types and for adjusting the reference quantization step size provided from the quantization step size setting means for each second image unit from the bit balance, as particularly recited in the independent Claims 1 and 11.

In view of the foregoing, the Applicant respectfully requests the Examiner to withdraw the rejection of independent Claim 1 and 11 pursuant to 35 U.S.C. § 103(a). Furthermore, Applicant respectfully requests the Examiner to withdraw the rejection of the dependent Claims 2-10 and 12-20 pursuant to 35 U.S.C. § 103(a), based at least on their respective dependencies from independent Claims 1 and 11, respectively.

In sum, the Applicant believes that the above-identified application is in condition for allowance and henceforth respectfully solicits the allowance of the application. If the Examiner believes a telephone conference might expedite the

allowance of this application, the Applicant respectfully requests that the Examiner call the undersigned, Applicant's attorney, at the following telephone number: (516) 742-4343.

Respectfully submitted,

Paul J. Esatto, Jr.
Registration No. 30,749

SCULLY, SCOTT, MURPHY & PRESSER
400 Garden City Plaza
Garden City, New York 11530
(516) 742-4343

AGV:eg/yd